KIRTLANDIA®

THE CLEVELAND MUSEUM OF NATURAL HISTORY

CLEVELAND, OHIO FEBRUARY 5, 1970 NUMBER 8

TREMATOPS STONEI SP. NOV. (TEMNOSPONDYLI: AMPHIBIA) FROM THE WASHINGTON FORMATION, DUNKARD GROUP, OHIO

EVERETT C. OLSON
University of California at Los Angeles

ABSTRACT

Trematops stonei, a new species of this genus of temnospondylous, labyrinthodont Permian amphibian, is described and figured. The specimen upon which the description is based was found in the Creston Shale, Dunkard Group, Lower Permian at Marietta, Ohio. This genus, along with *Melanothyris* (previously known from the Dunkard), and *Dimetrodon* and *Diadectes,* recently obtained from a channel-fill deposit at Belpre, Ohio, indicate the presence of a terrestrial component in the Early Permian faunas of this region. This part of the faunal complex is rarely represented in the usual pond-lake deposits of the Dunkard Group.

INTRODUCTION

The vertebrate fossils of the Dunkard Group have become fairly well known through the studies of Moran (1952), Romer (1952) and Beerbower (1963). Extensive collections have come from Ohio, Pennsylvania and West Virginia. These include many as yet undescribed specimens so that faunal considerations, based as they must be upon published information, are necessarily somewhat incomplete. Among the collections of the Cleveland Museum of Natural History is the skull described in this paper. It is of sufficient interest that its description cannot await studies of other collected but undescribed materials.

Over the areas in which the Dunkard occurs, a more or less continuous sequence of fossiliferous beds includes deposits formed in the Late Pennsylvanian (Stephanian) and Early Permian (Autunian). Finds of vertebrate remains in these beds are widely scattered geographically and the fossils are for the most part fragmentary. Outcrops are limited by the heavy cover of vegetation over the area, and remains have in large part come from roadcuts or persistent exposures created by resistant limestone. Nevertheless, representatives of nearly 30 genera and species have come from the Dunkard portion of this sequence, comprising several groups of fishes, amphibians and reptiles. These, for the most part, are, at a generic level, similar to the Late Pennsylvanian and Early Permian vertebrates found in the better known areas of the Midcontinent region, including northcentral Texas, Oklahoma, Kansas, New Mexico, Colorado and Utah. In addition, there are striking similarities to the Late Pennsylvanian vertebrates from the Oakwood locality of Illinois (see Olson, 1946). A few genera, the best known of which are *Diploceraspis* and *Megamolgophis,* are absent from Midcontinent collections.

Both the Pennsylvanian deposits (Conemaugh and Monongahela) and the Permian Dunkard are of the general "coal measures" type, including sandstones, shales, clays and freshwater limestones, along with coal. The gray dolomite and shale series of the Wellington Formation of northcentral Oklahoma, except for the absence of coal, approaches this depositional pattern most closely of Midcontinent vertebrate-bearing formations. The predominant sediments in both areas indicate deposition in shallow waters along the shores of large freshwater lakes. In both areas occur sandstones and conglomerates deposited by current action. From such deposits, more commonly in Oklahoma than in the eastern United States, have come some fragmentary remains of kinds of animals not usually encountered in the typical lake beds.

It is from such a deposit that the specimen that occasioned this paper came. In February, 1969, Reed W. Irwin, a member of a Marietta College field party investigating local Dunkard stratigraphy under the direction of Dr. Dwayne D. Stone, discovered the specimen. It is part of a growing collection of Dunkard vertebrates in the Cleveland Museum of Natural History. The specimen came from the upper, green to gray beds of the Creston Shale (red beds) of the Washington Formation, Dunkard Group, of Ohio. David Dunkle turned the specimen over to me for study. It had been excellently prepared by Peter R. Hoover. The illustrations were prepared by Eleanor Daly. I here express my appreciation to each of these persons for their contributions to this study. The work was supported in part by National Science Foundation Grant GB 13910.

SYSTEMATIC PALEONTOLOGY

Class AMPHIBIA

Subclass LABYRINTHODONTIA

Order TEMNOSPONDYLI

Family TREMATOPSIDAE Williston, 1910

Genus **TREMATOPS** Williston, 1909

TREMATOPS STONEI[1] sp. nov.

Figs. 1, 2

Diagnosis: A moderately large species of *Trematops* with length of skull of holotype (only known specimen) about 140 mm, as measured along the dorsal midline, slightly less than for known adult specimens of *T. milleri* Williston. Marginal maxillary dentition comprising relatively few, large, strongly labyrinthine teeth. Tusk and pit on palatine bone strongly developed.

Holotype: Cleveland Museum of Natural History 10969, a partial skull.

Horizon: Creston Shale (red beds) of the Washington Formation, Dunkard Group, Lower Permian, immediately below the Upper Marietta Sandstone.

Locality: Roadcut on Ohio Route 7, at Marietta, Washington County, Ohio, 0.7 mile southwest of U.S. Route 50A.

Repository: Cleveland Museum of Natural History, Cleveland, Ohio.

Description: The principal features of the skull are as shown in figures 1 and 2. The specimen is somewhat distorted and the marginal portions, except forward from the midorbit on the left side, much of the palate, and part of the snout are missing. A typically trematopsid, large elongated narial fenestra is preserved on the left side. The braincase, basicranium, parasphenoid, sphenethmoid and interorbital-internasal septum are well preserved and show considerable detail. All of these structures conform very closely in form and size to those present in *T. milleri*.

---

[1] The species name is given in recognition of Professor Dwayne D. Stone of Marietta College, whose interest and inquiry about the specimen ultimately resulted, with his cooperation, in its acquisition by the Department of Paleontology of the Cleveland Museum of Natural History.

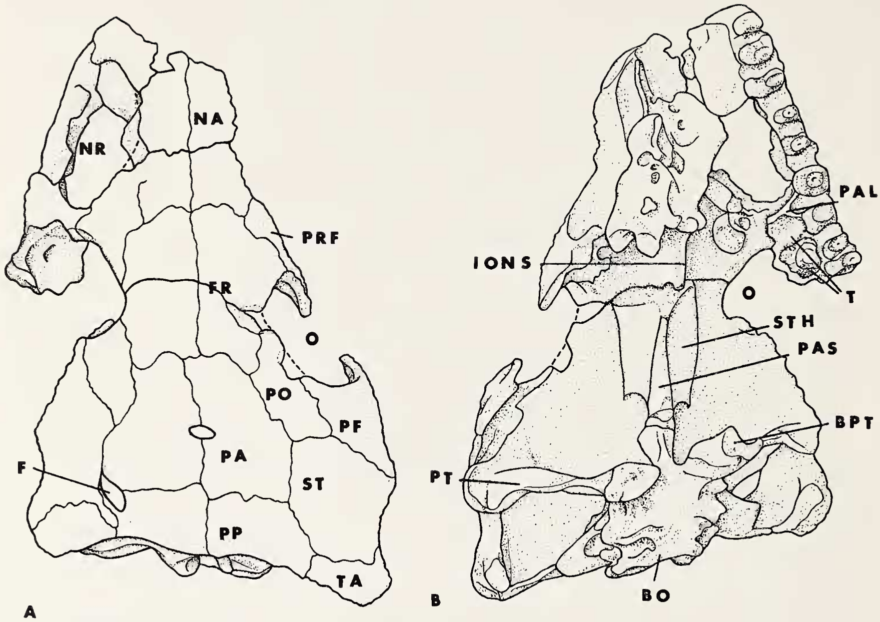

Fig. 1. The skull of *Trematops stonei* sp. nov., × ½. A. dorsal view; B. ventral view. Abbreviations: BO, basioccipital; BPT, basipterygoid process; F, fossa on parietal platform; FR, frontal; IONS, interorbital-internasal septum; NA, nasal bone; NR, naris; O, orbit; PA, parietal; PAL, palatine; PAS, parasphenoid; PF, postfrontal; PT, pterygoid; ST, supratemporal; STH, sphenethmoid; T, tusk and pit on palatine.

The dorsal platform and lateral dermal surface of the skull carry the usual reticulate, sculptured pattern found among the labyrinthodonts. Although the bone is riddled by small, mineralized fractures, the sutural pattern has remained moderately clear and the reconstruction in figure 1 is reliable. On the left side of the parietal shelf, a small, anomalous, elliptical fossa passes through the bone (F in figure 1A). It has well-formed, smooth finished edges. It will be noted in the figure that the sutural pattern in the vicinity of this opening is somewhat altered, showing that the fossa was formed early in ontogeny and that it interrupted normal bone growth. Whether it was a genetic defect or was induced by an early mechanical interruption of normal growth cannot be determined.

Assignment: Reference of this specimen to the family Trematopsidae poses no difficulties for it is similar in all gross features to the

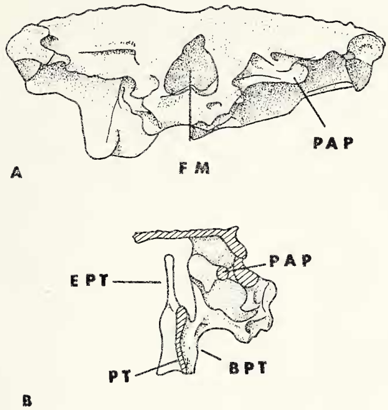

Fig. 2. *Trematops stonei* sp. nov., × ½. A. occipital view; B. braincase in lateral view, lateral dermal bones removed. Abbreviations: BPT, basipterygoid process; EPT, epipterygoid; FM, foramen magnum; PAP, paraoccipital process; PT, pterygoid bone.

best known members of this family, *Acheloma* and *Trematops*. The large, elongated external nares, the pattern of the dorsal and lateral dermal bones, the strongly deflected basipterygoid processes, which are fused to the pterygoids, the form of the braincase, including the high, slender epipterygoid, and the narrow cultriform process of the parasphenoid, which fails to meet the vomer anteriorly, are the primary bases for this relationship (see Olson, 1941).

Recently Vaughn (1969) considered the relationships of the families Trematopsidae and Dissorophidae. On the basis of his new genus *Ecolsonia,* which incorporates some features of dissorophids although it is clearly trematopsid, he provided strong support for the concept of close relationship between the two families. DeMar (1966) described *Longiscitula,* an animal which has an elongated, trematopsid-like narial opening, but is basically dissorophid in many features. This, like Vaughn's genus, indicates that the families are closely related but that they had undergone considerable divergence from an unknown stock which must have existed well prior to the Permian.

The only problem of generic assignment of *T. stonei* has been whether it belongs to the genus *Acheloma* or to *Trematops,* which, as discussed in an earlier review (Olson, 1941), are very similar. As far as the structure of the skulls is concerned, the differences are such that they could be judged to be either of specific or of generic value. In instances where the structure is known, the frontal bone is shorter in relationship to the parietal in *Trematops* than in *Acheloma,* the tabulars are relatively larger, the nasals relatively longer and the squamosals relatively smaller. Postcranial differences are somewhat more definitive. Most important is the complete ossification of the hypocentra above the notochordal opening in *Trematops* and the incomplete ossification in *Acheloma.* In addition the coracoids are better ossified in *Trematops* and the scapular blade is erect in *Trematops* and reflected posteriorly in *Acheloma* (Olson, 1941). The significant postcranial differences, of course, are not applicable at present to placement of the new species.

On the basis of the relatively short frontal, the moderately large tabular and the relatively strong ossification of the braincase, the Dunkard specimen is referred to the genus *Trematops* rather than to *Acheloma.* It is considered to be distinct from *T. milleri,* which it most closely resembles in size and proportions, primarily on the basis of the marginal and palatal teeth. Although the full tooth row is not present in the Dunkard specimen, it is probable that the total number of marginal teeth did not exceed 20. The teeth preserved in *T. stonei* are robust except for the most posterior three, which show rapid reduction in size. This contrasts somewhat with the teeth of *T. milleri,* which are comparably large only at the level of the anterior part of the orbits and the posterior part of the naris. In addition, the palatal tusk on the palatine bone of *T. stonei* is very strong compared with that of other species of *Trematops.* These are minor morphological differences and the few known specimens do not indicate what role variation may have played. They do, however, offer a morphological basis for separating the one known specimen of *T. stonei* from those of *T. milleri,* a separation that is suggested as well by the significant time interval between the two, the one coming from the very beginning of the Permian and the others from Clear Fork beds (Arroyo Formation) in the middle Leonardian.

Measurements in millimeters of the skull dimensions of the holotype and only known specimen of *Trematops stonei* sp. nov. C.M.N.H. 10969 are as follows:

Skull length, along dorsal midline	140
Parietal length, along midline	33 (left) 37 (right)
Postparietal length, along midline	17 (left) 13 (right)
Frontal length, along midline	38
Skull width, least width between otic notch margins on skull platform	86
Narial length, maximum	37

OCCURRENCE AND SIGNIFICANCE

The specimen of *T. stonei* sp. nov. was found near the top of the "red shale" interval, the Creston Shale, between the lower and the upper Marietta sandstones of the Washington Formation. Over the years the status of the Washington as a formation or a more comprehensive stratigraphic unit has been debated (see Hennen, 1911, McCue, et al. 1948, Hickock and Moyer, 1940, Moran, 1952, and Nace and Bieber, 1958). For the purposes of this study the conceptual differences involved in these discussions are unimportant and for simplicity the Washington is considered to be a lithologically complex formation. The thickness of the formation ranges from about 250 to 400 feet. Included, along with the sandstones mentioned above, are five coals and four limestones.

The Creston Shale ranges between 35 and 60 feet in thickness and lies between the Middle Washington Limestone below and the Washington "A" Coal above. The latter is a reworked coal in the area where the specimen was recovered. Overlying it is the Upper Marietta Sandstone which has channeled to varying degrees into the underlying beds. This sequence represents a variety of environments of deposition among which some, such as the Creston Shale, give indications of being in part terrestrial. The only other vertebrate remains from the Creston are a fragment of a spine of *Edaphosaurus* found at Marietta, Ohio, by Stauffer (Stauffer, 1916, Stauffer and Schroyer, 1920, Moran, 1952) and coprolites reported by field parties from Ohio University. All specimens have come from near the top of the beds.

The vertebrates add little to an understanding of the age of the deposits. The Washington beds form the lower part of the Dunkard and are generally placed as very early Permian (Moran, 1952) or possibly as bridging the Stephanian-Autunian boundary (Dunbar, et al. 1960, Beerbower, 1963).

The most fossiliferous locality in the Washington that has been fully described to date is locality 6 of Moran (1952) located in the SW¼ sec. 18, T. 3 N., R. 4 W., Monroe County, Ohio, about 40 miles northwest of Marietta. The fossils came from a series of limestones and shales which ranges from 2 to 4 feet in thickness. The beds lie about 7 to 10 feet below the Washington "A" Coal and are thus more or less comparable in stratigraphic position to the site from which *T. stonei* sp. nov. was taken. As identified by Romer (1952) this assemblage includes:

Dittodus sp. (=*Xenacanthus* sp.)
Sagenodus cf. *S. periprion*
Eryops cf. *E. megacephalus*
"Branchiosaurs"
Rhachitomi indet.
Diploceraspis burkei
Lysorophus dunkardensis (presence not certain)
Melanothyris morani (a jaw possibly pertaining to the genus and species)
Edaphosaurus cf. *E. boangeres*
?*Baldwinonus dunkardensis* (jaw fragment)

Collections made during the last few years have produced an extensive vertebrate assemblage from Belpre, Washington County, Ohio. This has been reported by Hlavin, Windle and Wilcoxen (1968). A heretofore unpublished faunal list from this locality supplied by William Hlavin is as follows:

Ctenacanth-cladodont group (teeth and spines)
Xenacanthus sp.
cf. *Ectosteorhachis* sp.
Sagenodus sp.
Elonichthys sp.
Eryops cf. *E. megacephalus*
Rhachitomi indet.
Diploceraspis sp.
Lysorophus sp.
Megamolgophis sp.
Diadectes sp.
Edaphosaurus cf. *E. boangeres*
Dimetrodon sp.
Pelycosaurs, indet.

Some specimens from this site were kindly sent to me by Mr. Hlavin and these give some added insight into the vertebrates present at Belpre. A rhachitome, (probably *Eryops*), *Diploceraspis, Diadectes, Edaphosaurus* (cf. *E. boangeres*), *Ophiacodon* and *Dimetrodon* are readily identified in this assemblage. In addition a large vertebral centrum probably is from *Megamolgophis,* although it is not beyond the size range of the largest Texas and Oklahoma specimens of *Lysorophus.* Furthermore, a very large, rugose, tooth-bearing portion of the margin of the skull of a large labyrinthodont is present. This represents *Edops* or a very *Edops*-like amphibian.

The Belpre locality lies about 10 miles southwest of the Marietta *Trematops* locality, and the specimens were found directly above the Upper Marietta Sandstone. The bone-bearing deposit represents a channel-fill and is composed of pebbles up to 2 inches in diameter. The vertebrate remains were evidently washed in and, although they are well preserved, they are fragmentary.

The fossils at locality 6 of Moran (1952) portray a typical fresh-water pond and pond-margin array. Throughout much of the Washington and the overlying Greene Formation such assemblages predominate. Beerbower (1963) in his discussion of the paleo-ecology of *Diploceraspis,* which covered most of the sites for which substantial samples were known, indicated the predominant environment as that of "lakes and ponds." The few identified stream channels, except the one at Belpre, have yielded mostly unidentifiable scraps. None of the fossil-producing beds described by Moran (1952) and Romer (1952) were formed by deposition in stream channels.

This has resulted in a strong bias in preservation of types of habitats, occasioned in large part, it would seem, by the fact that resistant limestones provide the bulk of the outcrops. Natural stream cuts and even road cuts in other materials are rapidly obliterated. It seems highly likely that, as in the Midcontinent area, more terrestrial environments existed adjacent to the standing waters. Fragments and a few more complete specimens from the Washington Formation have given indications of such environments. From Blacksville, West Virginia, *Melanothyris,* a small romeriid captorhinomorph, is indicative of a terrestrial habitat, although the specimens were preserved in limestone nodules.

Elsewhere specimens of *Lysorophus* are known, and *Megamolgophis* has come from one Washington locality. *Lysorophus* is quite certainly an aestivator and, on the basis of great similarity of structure, *Megamolgophis* probably was as well. The distinctions between the Dunkard *Lysorophus* specimens and those from Texas were based primarily on size, expressed in length of vertebral centra. It is now clear that the size ranges in the two regions completely overlap and that there is no adequate morphological basis for separation. The vertebrae of *Megamolgophis* are somewhat larger than those of the largest *Lysorophus* from the Texas area, with the average central length as noted by Romer (1952) of 15 mm, about 2 mm greater than the largest known from the Choza of Texas and the Hennessey of Oklahoma. There is, as far as the vertebrae are concerned, no reason to presume the habits to have been different. The skull materials referred with some hesitation to *Megamolgophis* by Romer (1952) indicate a quite different animal and, if the association is correct, may suggest a very different way of life.

If *Lysorophus* and perhaps *Megamolgophis* are indicative of aestivation, they suggest the existence of seasonality in the climate of the Dunkard area. It should be noted, however, that as yet no evidence of the commonly aestivating dipnoan, *Gnathorhiza,* has been reported.

Although much of the Belpre assemblage has the same general cast as that from locality 6 of Moran (1952), the presence of *Dimetrodon* and also of *Diadectes* suggests that somewhat different ecological circumstances may have contributed elements to the total assemblage. The large *Ophiacodon* at Belpre similarly suggests that at least partially terrestrial pond and stream margins were sources of parts of the faunal assemblage.

In this array of Washington specimens, however, even with such genera as *Diadectes, Ophiacodon* and *Dimetrodon* present, *Trematops* is something of an oddity. The genus is not a typical representative of pond or lake assemblages in the Texas-Oklahoma regions, where it is well known. *Acheloma* from the Wichita beds perhaps comes slightly closer to filling such a role, but even it was probably relatively highly terrestrial. *Trematops* in its typical occurrences is associated with dissorophids, *Seymouria,* captorhinids and *Dimetrodon.* It does not occur, except as possible fragments, in stream deposits or in typical pond deposits characterized by

Xenacanthus, palaeoniscoids, *Trimerorhachis, Eryops, Diplocaulus, Edaphosaurus* and, of course, the ubiquitous *Dimetrodon.*

The specimen of *T. stonei* in the Creston Shale of the Washington Formation gives very clear evidence, along with *Melanothyris,* of the existence of a truly terrestrial life zone in the mideastern region of the United States during the Early Permian. It would appear that the various faunal subgroups, well known in the midcontinent, occupying standing water, streams, margins of the ponds and streams and the low divides or "uplands" persisted far to the east from the places in which they were first recognized.

REFERENCES CITED

Beerbower, J. R., 1963, Morphology, paleontology and phylogeny of the Permo-Carboniferous amphibian *Diploceraspis*: Mus. Comp. Zool. Bull., v. 130, p. 31-108.

DeMar, R. E., 1966, *Longiscitula houghae,* a new genus of dissorophid amphibian from the Permian of Texas: Fieldiana, Geology, v. 16, p. 45-53.

Dunbar, C., et al., 1960, Correlation of the Permian Formations of North America: Geol. Soc. America Bull. 71, p. 1763-1806.

Hennen, R. V., 1911, Wirt, Roane and Calhoun Counties: West Virginia Geol. Survey, County Rept., 573 p. (Creston Shale: p. 154).

Hickock, W. O. and Moyer, F. T., 1940, Geology and mineral resources of Fayette County, Pa.: Pennsylvania Geol. Survey, 4th ser., Bull. C 26, 530 p. (p. 149-151).

Hlavin, W. J., Windle, D. B. and Wilcoxen, J. M., 1968, A newly discovered locality of Permian vertebrates in the Dunkard Series of Washington County, Ohio [Unpublished abs.]: Ohio Acad. Sci., 77th Ann. Meeting.

McCue, J. B., et al., 1948, Clays of West Virginia: West Virginia Geol. Survey Rept., v. 18, p. 9.

Moran, W. E., 1952, Location and stratigraphy of known occurrences of fossil tetrapods in the Upper Pennsylvanian and Permian of Pennsylvania, West Virginia and Ohio: Carnegie Mus. Ann., v. 33, p. 1-44.

Nace, R. L. and Bieber, P. P., 1958, Ground-water resources of Harrison County, West Virginia: West Virginia Geol. Survey Bull. 14 (Creston Shale: p. 18).

Olson, E. C., 1941, The family Trematopsidae: Jour. Geology, v. 49, p. 149-176.

————, 1946, Fresh and brackish-water vertebrate-bearing deposits of the Pennsylvanian of Illinois: Jour. Geology, v. 54, p. 281-305.

Romer, A. S., 1952, Late Pennsylvanian and early Permian vertebrates of the Pittsburgh-West Virginia region: Carnegie Mus. Ann., v. 33, p. 47-113.

Stauffer, C. R., 1916, Divisions and correlations of the Dunkard series of Ohio: Geol. Soc. America Bull. 27, p. 86-88.

——— and Schroyer, C. R., 1920, The Dunkard series of Ohio: Ohio Geol. Survey, 4th ser., Bull. 22, p. 1-167.

Vaughn, P. P., 1969, Further evidence of close relationship of the trematopsid and dissorophid amphibians with a description of a new genus and species: Southern California Acad. Sci. Bull., v. 68, p. 121-130.

MANUSCRIPT RECEIVED NOVEMBER 2, 1969